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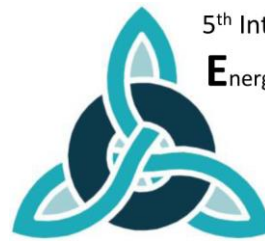
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Computational efficient thermo-mechanical modelling of interconnects in SOFC stacks including the effect of contact

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Currently it is computationally challenging to perform thermo-mechanical analysis of the entire solid oxide fuel cell (SOFC) stack at operational conditions, especially if details of the geometry of profiled metallic interconnects are considered. This is particularly the case when the metallic interconnect is modeled considering time-dependent plasticity or creep at high temperature in addition to elasticity. In this work, this problem is addressed using computational homogenization techniques, whereby the effect of the geometry is built into an effective anisotropic material law for a continuum block of material, which is formulated to represent the interconnect in the stack model. Here the approach is exemplified using a sinusoidal shaped corrugated metallic interconnect. Hence, the study presents a finite element model to calculate the homogenized elastic and creep responses of the metallic interconnect at high temperature. Thereafter, a constitutive law for the homogenized structure (effective material law) is developed. In order to properly describe the mechanical behavior of the interconnect at high temperature, deformations involving the elastic, creep as well as effect of changes in the geometry due to contact must be accounted for. A novel method is used in this work to particularly handle the latter or geometry induced non-linearities due to contacts. Finally, the developed constitutive law is verified by comparing its predictions for creep strain with results from the original 2D finite element model for different loading conditions. The constitutive law is found to satisfactorily describe the mechanical behavior of corrugated metallic interconnect with computational feasibility and significant speed gain.

Keywords: Solid oxide fuel cells, Metallic interconnect, Homogenization, Creep